

Oklahoma Space Industry
Development Authority

Summary of Research
for NASA Research Grant NAG-1-01056

A publication of the
Oklahoma Space Industry Development Authority
December, 2002

I. Introduction:

The purpose of this grant was to increase the awareness of students of space sciences and commerce through experimentation. This objective was carried out through the award and administration, by the Oklahoma Space Industry Development Authority, of eleven smaller grants to fund thirteen projects at schools determined by competitive application. Applications were graded on potential outreach, experimentation objectives and impact on students' awareness of space sciences. We chose projects from elementary, middle and high schools as well as colleges that would encourage students through research and experimentation to consider education and careers in related disciplines. Each organization did not receive an equal share of the grant; instead, OSIDA distributed the money to each project based on the organization's need. A copy of the disbursement record is enclosed with this final grant report.

II. The Projects:

A. The Greatest Mars Adventure

For *The Greatest Mars Adventure*, Roosevelt Middle school of the Oklahoma City Public Schools system was granted \$35,268.00 to offer 375 middle school students (grades 6-8) the opportunity to gain hands-on learning experience about space colonization. This project was organized through the Technology Education program. The students spent several weeks learning about the Red Planet as well as about basic engineering processes NASA scientists use.

The basic concept was that the students were establishing a colony on Mars. The students built a “colony control central” They adapted a go-cart to serve as their own version of the Mars Rover and a remote control plane to search for water on their new home. Further, they planted gardens within the control center to supply their colonists with food. Project coordinator, and teacher, Patrick Dennis, spent a full semester teaching students the principles they would need to employ as they built their colony. They began with creating models of their control center and developing methods of establishing their new life on Mars. As the semester continued, the students’ interest in space technology sciences grew. The program culminated with a full-day’s event when the students turned their school’s playground into the Mars surface. Their enthusiasm was evident, along with their knowledge of the program and their group’s plans.

This project offered students an opportunity to learn engineering principles, basic facts about Mars (and the planets, in general) and, perhaps most importantly, to use their imaginations to dream toward future advances in space technology.

Their money was spent to purchase supplies such as a remote control airplane; a go-cart; the supplies to build a metal dome (where their control center was based); gardening supplies; Walkie-Talkies; wireless video equipment, batteries and electric supplies, a 200 Watt solar system and curriculum supplies.

B. Star Station One

The Kirkpatrick Science and Air and Space Museum at Omniplex (Omniplex) received \$30,000 to expand on their *Star Station One* Program. The program's primary purpose is to offer elementary school students realistic simulations of the space station experience. For example, one simulation involves "space goggles:" glasses that skew the wearer's vision in the same way vision is skewed in space. Another simulation features a robotic arm that allows the students to work with the mechanical piece in a way similar to the way an aerospace engineer would. The program is taught in a workshop-style fashion, with activity, discussion, lectures, and questions. The instructors are innovative educators, licensed to teach in the State of Oklahoma, and employed by the Omniplex in the museum's education division.

The staff at the Omniplex was able to expand upon this program by partnering with 99 rural schools (as well as one multi-school space conference) to offer 109 presentations to 30,000 students. They used the money to purchase promotional items and some basic presentation equipment (such as posters, banners, storage units, etc.). Further the money funded the activity supplies for approximately 300 students per site and paid for the travel costs of the instructors. Also, two presenters attended the International Space Station Educator's Conference in Houston, TX, where they were

provided with current, in-depth ISS information to augment their presentation skills for the outreach program. This required travel, lodging, and registration (Registration was paid by the Omniplex).

The Omniplex is a charter partner of the *Star Station One* program and is also the only entity in the state of Oklahoma that offers this established, nationally-known program. Overwhelming feedback from teachers and students applauded the program as well as the presenters' performance.

C. REACH for the Stars

With their \$13,600.00 grant, Norman Public Schools purchased one Starlab Planetarium, six equatorial mounted refracting telescopes and six celestial spheres. Further, the astronomy faculty developed and implemented innovative curricula to advance the classroom experience. These 180 high school students participated in activities where they 1) constructed a definition for constellations, 2) identified the location of circumpolar and seasonal constellations, 3) identified the impact of their location on earth on constellations, 4) learned the historical significance of constellations among various cultures, 5) used celestial coordinates systems to locate stars, and 6) learned the significance of the position of celestial objects to navigation on earth and in space. Finally, students were able to apply these concepts to real-life as they participated in locating and viewing objects of the night sky through refracting telescopes twice during the semester.

D. Commerce Middle School Space Education Program

Commerce Middle School, located in an economically-challenged rural community, used their \$10,662.01 grant to establish a space curriculum for their school. Some of the activities the students participated in were: 1) classroom discussions regarding Newton's Laws of Motion; flight principle; and the history of the space program. 2) Multi-media presentations such as videos and CD-ROM presentations of space exploration. 3) Model rocketry design, study and flight stages (using both water and solid-fuel rockets). 4) Various class experiments involving rockets and space flights. 5) Tour of the Omniplex Air and Space Museum in Oklahoma.

With their grant, they purchased videos, interactive learning tools such as CDs, various educational supplies, transportation to the Omniplex, as well as admission to the Omniplex, and a salary for the course instructor, Shanna Miller. 65 students participated in the program.

This multi-faceted curriculum is also serving as a model for neighboring school districts interested in developing similar programs. Shanna Miller, said this regarding the program, "Our students are now provided with the technological experiences, hands-on experiences, and instructional opportunities that we have not been fortunate enough to provide in the past. The Space Education Program has been a wonderful project for our teachers as well as for our students."

E. Rocketry 101: Igniting creativity through interactive exploration

This five-day workshop developed and implemented by Oklahoma State University (with help from the Tulsa public schools GEAR-UP program), provided

eighteen minority and economically-deprived high school students with the opportunity to learn rocketry principles in a classroom setting as well as in several hands-on experiences. The students were bussed from their school districts in North Tulsa to the Oklahoma State University campus where they attended sessions led by an aviation professor. Also, they each built rockets, worked with computer simulators, studied learning models and participated in other multi-media educational processes.

Beyond offering students educational opportunities they normally would not have, *Rocketry 101* allowed the students (many of whom have been labeled, “at-risk”) to get excited about futures in aerospace. Each student kept a journal and actively engaged in wrap-up discussions about rocketry and offered questions and ideas for the model rocket construction. The grant was for \$8,024.00. They purchased curriculum for the course, supplies for rockets, simulation equipment, various classroom supplies, a camera, instructor salary, and lunches for the students, and paid for transportation for the students.

F. Southwest00ern Oklahoma State University Fall Conference: “Stake Your Claim in Oklahoma’s New Frontier”

Unlike the other programs, this conference was designed to educate adult Oklahomans on the economic possibilities of space commerce. Representatives from various aerospace companies, as well as state and nationally-elected leaders made presentations regarding Oklahoma’s prospects in the space industry. This one-day conference was held at a premiere state-owned facility near the Oklahoma Spaceport and drew more than one hundred attendees. The conference attendees were also given the

opportunity to break into groups with a member of the OSIDA Board of Directors to ask questions and offer community insight to spaceport plans.

OSIDA did not fully-fund this program; their grant was in the amount of \$3,000 to cover partial expenses for the conference.

G. Opening of the Oklahoma Spaceport and the Frederick Global Space League

Takeoff Technologies received a total of \$34,000 to provide two launches of student-made payloads in Western Oklahoma. The first launch was part of the grand opening event of the Oklahoma Spaceport. This project involved the launch of a balloon-supported platform to 100,000 feet, where five hundred middle-school-student-made paper airplanes were released in space. Each airplane had a label affixed to it with instructions, a web address and an identifying number so that, when found, the finder could log onto the web site and post the finding with the identifying number. At that time, the student was notified that his or her plane had been found. Of the original \$32,000 in grant money, \$17,000 was disbursed to JP Aerospace for flight consumables and travel, \$10,000 to Digital Radiance for website-related costs, and the remaining \$5000 used for Takeoff's costs and incidental other expenses. There was significant match provided by JP Aerospace's volunteers as well as by the rest of the proposal team and various Oklahoma organizations.

Oklahomans drove from all over the state to see Oklahoma's first space launch. Members, of local, state, regional and national press were on-hand to cover the event and state leaders offered their enthusiasm for Oklahoma's future in space commerce. Local

sponsors provided coffee and breakfast for the launch team, hotel rooms for the agency and the launch team and other incidental costs such as transportation, etc.

The second launch, which received \$2,000, was part of a celebration in Frederick, Oklahoma called the Global Space League, to raise awareness of space-commerce advances in the area. Another balloon company (High Ships) was used. This time, the students who made planes were all from Frederick, rather than statewide. Between the two, more than 750 students participated in the events.

H. 2020 Vision and AirFest

The Tulsa Air and Space Museum received \$30,000 to design and build a multimedia exhibit. The exhibit titled *2020 Vision* features a spaceplane theater that houses 24 children or 12 adults. The “passengers” view a short film (with digital animation as the voyage continues) that simulates the experience of a spaceflight. The film takes viewers from a launch at the Oklahoma Spaceport (filmed on-location at Burns Flat, OK) to a new space colony. Along the way, the “spacecraft” stops to refuel, encounters other space traffic and swings past the International Space Station. Several minutes later, the passengers land safely back in Oklahoma. Beyond the visuals in the film, surround sound allows the passengers to hear the roar of the engines, the “captain’s” voice, and other noises that aid in the experience. The film was made by the project designer, Tim Espe, a contractor of the Tulsa Air and Space Museum, with help from students at the Spartan School of Aeronautics.

Their grant money paid for the construction supplies for the “spaceplane” (the frame is primarily made of fiberglass, the seats are from a retired airplane and other

supplies were used as necessary); a 65-inch flat-screen television and DVD player; digital editing equipment; and salary to the designer.

Since the exhibit's opening in September, it has become a favorite among museum visitors of all ages. The spaceplane is accessible to passengers with special needs, it is also air conditioned. As this is an ongoing exhibit, many Oklahomans will have the opportunity to experience it.

For the annual *AirFest*, a program designed to raise awareness of aerospace in and around Tulsa, the museum received \$1,000 toward their total program cost. This program drew many visitors to the museum to view the new *2020 Vision* exhibit, existing exhibits and other attractions brought in for the event. Featured speakers included retired astronauts and NASA engineers.

I. The Reusable Radiosonde

The University of Oklahoma's Department of Meteorology received \$12,844.00 to develop and test a reusable weather sensor and telemetry system, known as a radiosonde. Currently, radiosondes are only able to be used once. This disposable quality makes the instruments highly expensive to be used regularly (as they must, to offer complete and accurate weather information). In some areas of the world, the cost is prohibitive to any use of radiosondes.

The University's reusable instrument was designed by a professor and one undergraduate assistant who had the opportunity to use the project as a capstone experience. Its initial test was made in March of 2002 when it flew with the paper airplanes at the opening of the Oklahoma Spaceport. From the test, the designers

concluded that more work and greater testing was required for the instrument to offer its full potential to meteorologists. Further, this early design will serve as a platform for future advances to the equipment. With their work, comes the possibility for the team to bring the radiosonde to a follow-on project where they will have a greater hope of success.

Dr. Frank Gallagher, and his undergraduate student, used their grant money to purchase the supplies they needed to develop and test their design. These supplies included electronic devices, weather balloons, telemetry equipment and other necessary items.

J. Project ORION

Project ORION was an ambitious, two component pilot study approach to space science, education, training, and commercialization of space targeting instruction at elementary school and continuing teacher training. The focus of the project was to develop an interest and understanding of what science is and how it operates, an introduction to space exploration; past, present, and future, and an investigation into the basic skills needed for space travel and near future space exploitation. ORION was designed to be an integrated program with a primary goal of generating interest in space science and space exploitation among students and educators in western Oklahoma.

Three separate sessions were held: one for elementary school students, one for middle school students and one for teacher training. Each session had a cross-curricular, multidisciplinary design incorporating mathematics, technology and computers, language and writing, history and social studies, and several disciplines of science. The learning

experiences were comprised of “training centers” that featured specific learning objectives and make-and-take activities. Both groups of students were also taken on a field trip to the Thomas P. Stafford Air and Space Museum.

Project ORION received \$34,013 to be spent on eight Apple I-book computers; various software packages for experiential learning; supplies for make-and-take activities; other equipment for center-style learning; payroll for instructors; lunches for students; transportation and admission to the museum; production of computer CDs for students and teachers to take from the event and use in the future; other supplies as needed to complete the course.

A total of 144 students and 12 teachers participated in the program.

K. Launch Vehicle Design, Instrumentation, and Data Evaluation

The University of Oklahoma’s College of Engineering received \$28,464.00 to design and test an 11-foot high-powered aluminum rocket to fly at Mach 1.5 to 20,000 feet. The project was intended to provide data on the location and strength of the shockwave as the rocket penetrates the sound barrier. To this end, pressure and temperature sensors as well as strain gages and an accelerometer were to be built into the instrumentation section, together with on-board data loggers.

A graduate student and a number of undergraduate students at OU as well as students from Norman High School participated in the rocket project, and developed the equipment per the standards of their faculty advisors. One requirement was that the rocket break down into three sections, an instrumentation bay attached to the nose cone, an altimeter bay with housings for the parachutes, and a lower interface as interconnect to

the N-size motor. The students also required to design and create their own electronic equipment, including circuit boards.

At this time, the rocket has been built and instrumented, and is in the final testing phase. It has not yet been launched, due to weather delays and various semester breaks. We expect a launch at the end of January. If successful, the data analysis phase of the project will commence immediately, and a multimedia presentation will be put together.

III. The Impact

As Oklahoma is often dubbed, “an emerging space state,” it is clear that we must be prepared to expand our aerospace educational opportunities. These projects gave us that opportunity. Through a variety of projects that covered the geographic span of the state, young Oklahomans were able to become exposed to aerospace science through innovative, hands-on learning experiences. In the short-term, these students found practical, interesting applications for math and science; in the long term, they, along with others they may influence, can bring these early educational experiences to a university or a future career.

Additionally, many of these projects received press coverage. This allowed for people throughout the state to recognize that exciting times are in store for Oklahoma aerospace. This recognition contributed to a renewed sense of frontierism in our state. Oklahomans are beginning to see that Oklahoma has a future in space; and that the space industry has the potential to offer their children rich and rewarding careers.

Overall, the thirteen projects were enormously successful, due to the lasting impacts on the participants and the state as a whole. Each project focused on a unique

and specific audience and had a specific objective. For this reason, OSIDA feels that the grant funds were used in the most comprehensive manner possible.

IV: Dispersement Record**Commerce Middle School**

| | |
|-----------------|-------------------|
| Dec. 6, 2001: | \$2,679.11 |
| Jan. 25, 2002: | \$2,679.11 |
| May 13, 2002: | \$2,665.00 |
| Sept. 23, 2002: | <u>\$2,638.79</u> |
| TOTAL: | \$10,662.01 |

Norman High School

| | |
|---------------|-------------|
| May 13, 2002: | \$13,600.00 |
|---------------|-------------|

Oklahoma State University

| | |
|----------------|-------------------|
| Dec. 6, 2001: | \$2,006.00 |
| Jan. 25, 2002: | \$2,006.00 |
| May 13, 2002: | \$2,006.00 |
| Dec. 4, 2002: | <u>\$2,006.00</u> |
| TOTAL: | \$8,024.00 |

Omniplex (Kirkpatrick Air and Space Museum)

| | |
|-----------------|-------------------|
| Dec. 6, 2001: | \$7,500.00 |
| Jan. 25, 2002: | \$7,497.25 |
| May 13, 2002: | \$7,497.25 |
| Sept. 23, 2002: | <u>\$7,505.50</u> |
| TOTAL: | \$30,000.00 |

Oklahoma City Public Schools (Roosevelt Middle School)

| | |
|----------------|-------------------|
| Dec. 6, 2002: | \$9,975.00 |
| Jan. 25, 2002: | \$17,372.94 |
| May 13, 2002: | <u>\$7,920.06</u> |
| TOTAL: | \$35,268.00 |

Southwestern Oklahoma State University (Project ORION)

| | |
|----------------|--------------------|
| Dec. 6, 2002: | \$14,013.00 |
| Jan. 25, 2002: | \$10,000.00 |
| May 13, 2002: | <u>\$10,000.00</u> |
| TOTAL: | \$34,013.00 |

Southwestern Oklahoma State University (Fall Conference)

| | |
|----------------|---------|
| Nov. 15, 2002: | \$3,000 |
|----------------|---------|

Takeoff Technologies

| | |
|----------------|-------------------|
| Dec. 6, 2002: | \$16,000.00 |
| Jan. 25, 2002: | \$16,000.00 |
| Aug. 16, 2002: | <u>\$2,000.00</u> |
| TOTAL: | \$34,000.00 |

Tulsa Air and Space Museum

| | |
|-----------------|-------------------|
| Dec. 6, 2001: | \$7,500.00 |
| Jan. 25, 2002: | \$7,500.00 |
| May 13, 2002: | \$7,500.00 |
| Sept. 23, 2002: | \$7,500.00 |
| Nov. 15, 2002: | <u>\$1,000.00</u> |
| TOTAL: | \$31,000.00 |

University of Oklahoma (Dept. of Meteorology)

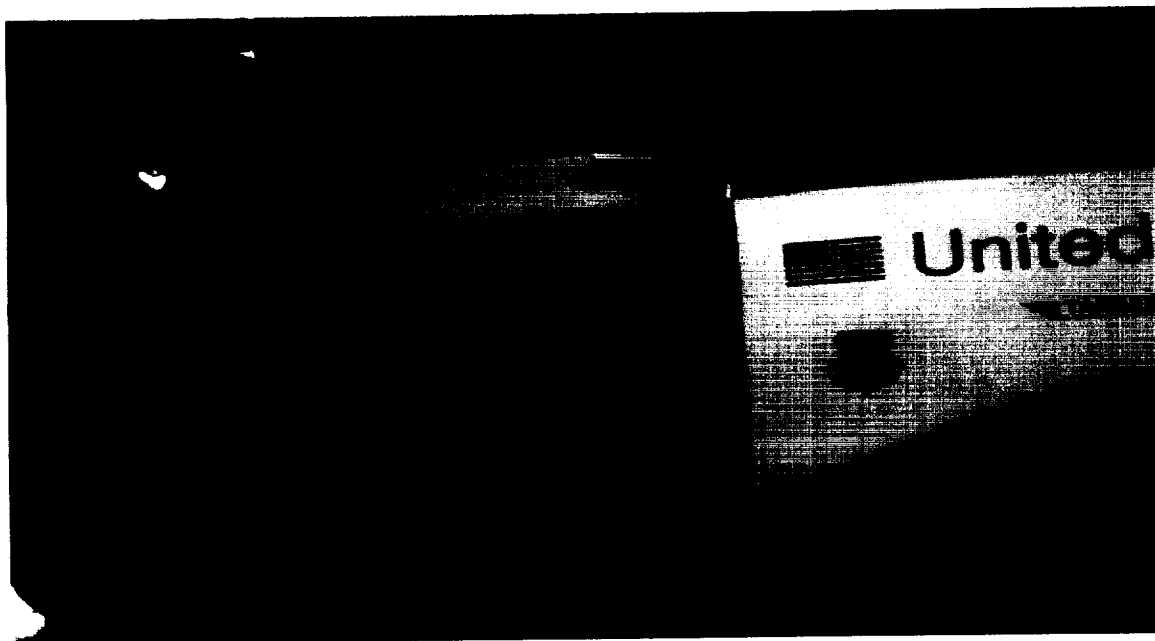
| | |
|----------------|-------------------|
| Dec. 6, 2001: | \$3,211.00 |
| Jan. 25, 2002: | \$3,211.00 |
| May 13, 2002: | \$3,211.00 |
| Oct. 14, 2002: | <u>\$3,211.00</u> |
| TOTAL: | \$12,844.00 |

University of Oklahoma (Dept. of Engineering)

| | |
|-----------------|-------------------|
| May 13, 2002: | \$21,348.00 |
| Sept. 23, 2002: | <u>\$7,116.00</u> |
| TOTAL: | \$28,464.00 |

COMBINED TOTAL OF GRANT PAYMENTS:**\$240,875.01****ADMINISTRATIVE COSTS TO BE RETAINED BY OSIDA:****\$8,524.99**

IV: Illustrations



Vision 2020 spaceplane-theater at the Tulsa Air and Space Museum



Class Picture from *Rocketry 101*



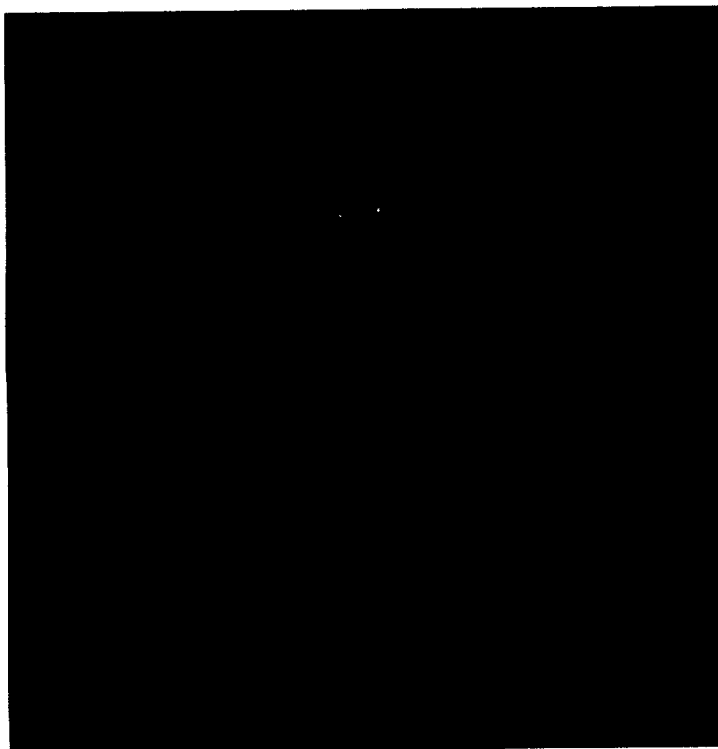
Students making paper airplanes to be dropped from space at the *Opening of the Oklahoma Spaceport*



Students with rocket for the University of Oklahoma's *Launch Vehicle Design, Instrumentation, and Data Evaluation*



A teacher works with a group of students at the fifth-grade *Project Orion* class



Rep. Frank Lucas addresses conference attendees at Southwestern Oklahoma State University's *Stake Your Claim in Oklahoma's New Frontier*